

An Overview of South Arkansas' Lignite
Research Program –
Commercial Testing for Energy Applications

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City, County and Local Affairs
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Outline

- Objectives and current status of the *Arkansas Lignite Resources Pilot Program* – Act 641
- Lignite to Crude Oil Technology
- AGS update on geologic modeling of drill hole data associated with Arkansas' lignite deposits
- Observations & Recommendations

Products Generated From Lignite

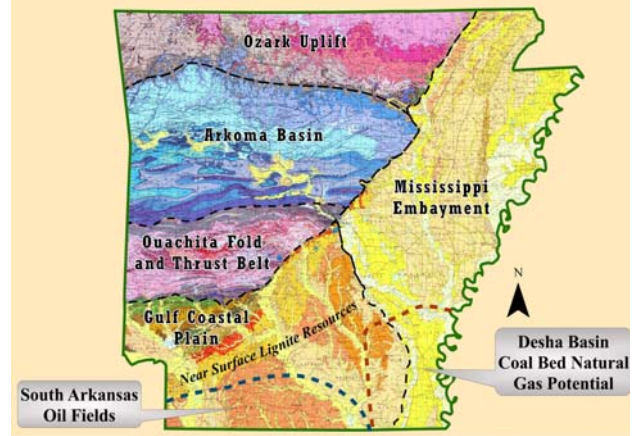
- ◆ Electricity
- ◆ Gasoline
- ◆ Ultra Clean Diesel
- ◆ Jet Fuel
- ◆ *Synthetic Crude Oil*
- ◆ Natural Gas
- ◆ Economically Important Bi-Products

Key Aspects of AR Legislation (Act 641)

- Act 641, Regular Session 2007, created the “*Arkansas Lignite Resources Pilot Program*”
- Excerpts:
 - “The Lignite Pilot Program shall be developed and administered by Southern Arkansas University, the Arkansas Geological Survey, and the Arkansas Department of Economic Development”
 - “Explore and utilize lignite as an energy resource including without limitation a Synfuels-based research program”
 - “Develop public and private partnerships with other entities to develop the untapped energy resource of lignite to stimulate Arkansas’ economy”
 - “Develop practical applications for the use of lignite resources as an alternative energy source”



Geologic Map & Provinces in Arkansas







**ASSESSMENT OF LIGNITE RESOURCES AND
UTILIZATION OPTIONS FOR THE STATE OF
ARKANSAS**

EERC Proposal No. 2008-0002

Submitted to:

Mr. Ed Ratchford

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for Michael L. Jones, Project Manager


Dr. Barry I. Mitrevic, Associate VP for Research
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July 2007



Previous Budget For AGS-EERC Project

(Submitted to Joint Energy - January 2009)

Requested Funds	Possible Source of Funds	Project Expenditures
\$850,000	State of Arkansas	Drilling contract for 75-100 lignite core holes
\$650,000	State of Arkansas	Commercial testing of lignite cores & Economic Report with development recommendations
\$550,000	EERC- Federal Matching Funds (DOE)	Commercial testing of lignite cores

Primary Objectives of the AGS-EERC Proposal

- Step 1: Secure 75-100 drill cores from the AGS for the commercial testing of south Arkansas lignite
- Step 2: Synfuels and Gasification testing of lignite at the EERC facility to assess the quality and characteristics of lignite for liquid fuels production (i.e. Gasoline, Ultra-Clean Diesel, Jet Fuel etc.) and power generation
(Compatible with Clean Coal Technology)

Primary Objectives of the AGS-EERC Proposal

- Step 3: Final Report submitted by the EERC to the AR Lignite Resources Pilot Program detailing the test results and enumerating several development pathways based on Arkansas' infrastructure (proximity to economic markets, transportation corridors, water availability, electrical power availability etc.)
- Step 4: Presentation by Representatives of the AR Lignite Resources Pilot Program to the Arkansas Legislature regarding the test results and development opportunities and recommendations

EERC Facilities – Grand Forks, ND



EERC Facilities



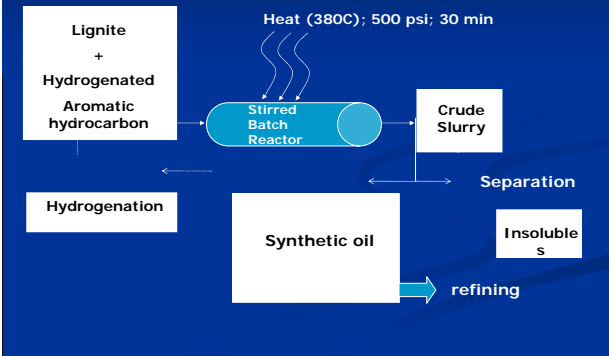
Promising Lignite Research & Observations

- University of TX at Arlington has successfully converted TX lignite to synthetic crude oil equivalent in quality to West TX intermediate crude
- UTA scientists are currently focusing on (1) Pyrolysis Conversion (2) Chemical Conversion {Hydrogen Donor Solvent} (3) Fischer-Tropsch via Gasification

Promising Lignite Research & Observations

- UTA micro refinery is mobile, 20' x 20' x 20', would cost about 5 - \$7 million and can produce up to 1000 barrels/day
- 10 micro refineries side by side could produce 10,000 barrels oil/day with added benefit of producing crude oil that can be blended with other crude oils from other refineries
- Lignite is much easier to convert to liquid transportation fuels than higher rank coals – in part due to the inherent higher ratio of Hydrogen to Carbon and a less aromatic chemical structure (more closely resembles crude oil composition & less aromatic and less problems with coking)

Hydrogen Donor Solvent – Exxon Patent



Micro Refinery Concept

- Placed at mine
- Moved as needed
- Low \$ to construct
- ~1,000 bpd



Microrefinery
Volume Achieved by Replication



Overall Objective



South Arkansas
Lignite

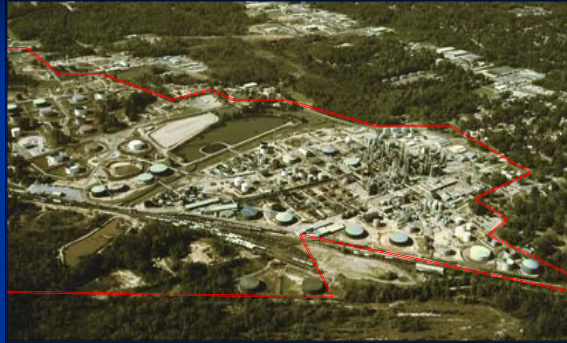


Synthetic
Crude



Oil Refinery

Lion Oil Refinery El Dorado Arkansas



75,000 BPD State of the Art Refinery



New Hydrogen Production Facility



Brand New Crude Unit Expansion
\$200 Million Investment

Syncrude Economics

Modified From: Richard Wilson, Bureau of Legislative
Research

TOTAL RESOURCE VALUE

Arkansas Lignite Reserves = 4 billion tons

Microrefinery produces 2bbl Syncrude per ton

Potential = 8 Bbbl X \$80 = \$640 B

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DAILY / ANNUAL PRODUCTION

10,000 tons per day = 20,000 bpd per mine site

Cost = \$40 per bbl (including mine cost)

Market price = \$80 per bbl

Annual revenue = \$584 million

Annual profit = \$292 million

4 billion tons / 20,000 tons per day = 200,000 days

200,000 / 365 = 548 years

### AGS Update on Lignite Research

- In 2007, the AGS secured research agreements with several industry partners to obtain lignite exploration drilling data covering an area of approx. 1.5 Million acres in south Arkansas
- The exploration data obtained from these agreements defines most of the major lignite deposits in the state
- AGS geologists and support staff are currently modeling the geological aspects of this data to assess the depth, thickness, and character of the lignite deposits



### Conclusions & Recommendations

- Arkansas' lignite resource is large, virtually untapped, and has a huge economic potential for development
- Our neighboring states of Mississippi, Louisiana & Texas continue to develop their lignite resources which creates high paying jobs and additional revenues for their states
- Act 641 was passed for the creation of **The Arkansas Lignite Resources Pilot Program** so that an “energy utilization strategy for lignite production can be developed”

## Conclusions & Recommendations

- The AGS recommendations are centered on development of Arkansas' lignite resources for liquid fuels development. This approach will likely yield a higher economic return for the state compared to utilization of lignite for electrical generation and could provide a more sustainable economic impact with a greater number of permanent jobs.
- A synthetic crude intermediate product provides an economic commodity with an existing market in Arkansas.

## Conclusions & Recommendations

- The Lion Oil Refinery in El Dorado is a modern facility that has a capacity of 80,000 bbls/day.
- Lion currently purchases crude from Saudi Arabia, Venezuela, and the Gulf of Mexico to blend with south Arkansas crude. Preliminary results from UTA indicate that Synthetic crude oil from Gulf Coast lignite is a desirable product that could be blended at the Lion Oil refinery.

### Conclusions & Recommendations

- The AGS is requesting \$3 Million in state funding to complete the drilling and commercial testing of the Arkansas lignite resource for gasification and coal-to-liquids development. Once funding is in place for the project, the drilling, testing and economic analysis of the test results is expected to be completed in 3 years.

**Thank You !**

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